—— The future of scientific research in Philadelphia is not hopeful. The school of biology of the University of Pennsylvania has been mainly placed in charge of men who are nearly or quite unknown in the field of original research, one of whom has publicly stated his doubts of its value! Another of the positions has been filled by a man who is only known as a worker in a widely different field. This arrangement we are told, is due to the fact that the services of these gentlemen are given gratuitously. The school of veterinary medicine has been put under direction of a veterinary physician who knows nothing of general comparative anatomy, so that a fine opportunity of fostering original research has been lost. The Academy of Natural Sciences has become a school for teaching instead of research. The only new enterprise in which it has recently engaged, has been the adoption of a new by-law, which is designed still further to diminish its usefulness.

Both the leading societies of the city allow the occupation of the hours of their regular meetings by amateur disquisitions on the rudiments of science, such as are well adapted for popular lectures, but are totally out of place in such institutions. All this may be traced to the imbecility and selfishness of a few of the leading workers in that city.

——:o:——

RECENT LITERATURE.

KRAEPELIN'S PROBOSCIS OF MUSCA.[1]—Kraepelin's paper gives the most complete account extant of the structure of an organ which has excited interest since the time of Aristotle. His investigations were chiefly on the proboscis of the Blow fly (*M. vomitoria*), and exclusively on its adult anatomy. The embryology of these parts has not been attempted by Kraepelin, baffled Weismann, and remains yet to be worked out. The following is an abstract of Kraepelin's paper, with pen-and-ink copies of the more important of his thirty-eight fine illustrations. I venture to add some criticisms in the form of foot-notes.

GEORGE MACLOSKIE.

PRINCETON, April 12, 1884.

I. CHITINOUS PARTS AND PRELIMINARY ORIENTATION.—The Muscidæ have nothing corresponding to the mandibles of other insects, and the first maxillæ are in a rudimentary condition; the second (or labial) maxillæ are well developed, coalescing and forming the chief part of the proboscis. There are also two unpaired pieces termed the labrum (oberlippe) and hypopharynx (Fig. 1, *o* and *h*). These lie imbedded in a furrowed channel (Fig. 2, *fp*) on the upper side of the cylindrical labium. The whole structure starts from the summit of a beak-like soft-

[1] Zur Anatomie u. Physiologie des Rüssells von Musca, von Karl Kraepelin, Hamburg. Zeit. f. wis. Zool., Bd. XXXIX, 1883, pp. 683–720, mit Tafel XL u. XLI.

skinned extension of the head. This conical head-part (Fig. 1, *bp*) being retrusible into the firm head-capsule (cranium, *c*) was

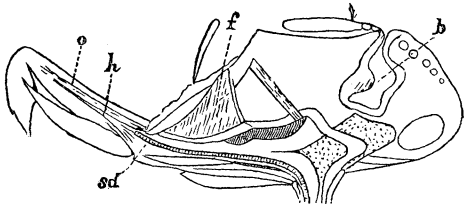

Fig 1.—Head of blow fly, all the figures enlarged.

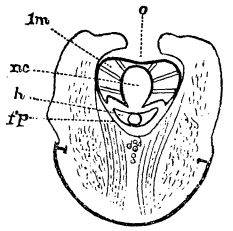

Fig. 2.—Section of Proboscis of the blow fly.

supposed to be the coalescing mouth-parts till Macloskie and Dimmock explained its true nature.[1] I shall call this soft head-part the "head-cone" (the basi-proboscis). The totality of the subsequent parts, including labium, labrum and hypopharynx (the medi-proboscis and disti-proboscis) I call proboscis in the strict sense.[2] (The so-called *epipharynx* has no existence.)

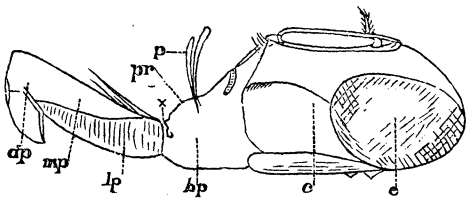

Fig. 3.—Proboscis of the blow fly.

Head-part of Proboscis (basi-proboscis, Fig. 1, *bp*).—The thin-walled basi-proboscis bears a pair of unsegmented palps (*p*) on its upper side, each resting on two chitin-ridges, one of which (*pr*) runs forward to the insertion of medi-proboscis, where it unites with a long rigid chitin-bar (one on each side, the *maxillary tendons*, Fig. 4, *mt*) which runs backward, free under the thin covering-membrane of the basi-proboscis. These bars are the rudimentary first maxillæ, whose palp-bearing part (*pr*) extends backwards coalescing with the roof of the basi-proboscis, and the belt-like pieces under the wall are in connection with the other trophi (especially the labrum) and frequently (in Mesembrina, Aricia,

[1] Macloskie in AMERICAN NATURALIST, 1880, p. 153, read before the N. J. Microscopical Society, Nov. 18, 1879, and N. Y. Academy of Sciences, Dec. 1, 1879. Dimmock's Inaugural Dissertation on the anatomy of the mouth-parts and sucking apparatus of some Diptera. Boston, 1881.

[2] The terms in parenthesis (basi, medi and disti-proboscis) were proposed by me in the article quoted, and are here retained as convenient renderings of the author's terms (kopf-kegel, eigentlicher Rüssel, labella). I do not think it wise to confine the term "proboscis" to the mid and distal parts, as that term is *functional*, indicating the entire mechanism for protrusion, however we may explain the homologies of its parts.—*G. M.*

&c.) bear a small piece (lade) which proves them to be basal parts of the first maxillæ.[1]

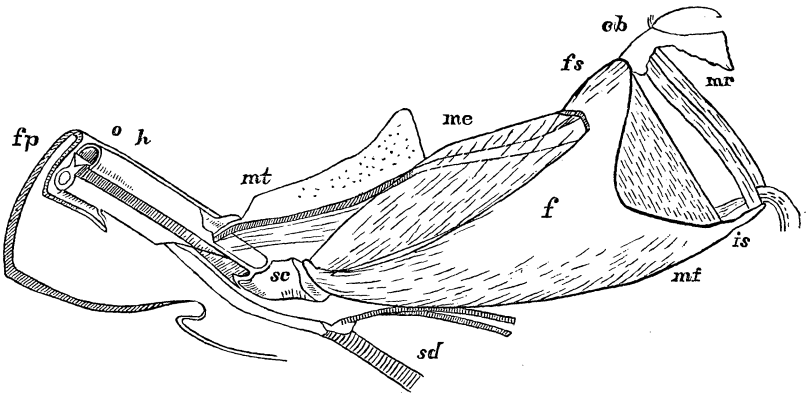

Fig. 4 —Proboscis of the blow fly.

Seen from above, the basi-proboscis shows a strong chitinous horseshoe-shaped thickening, with the open sinus forwards, lying below the soft skin of the basi-proboscis. This is the upper surface of a complex strong structure lying inside the basi-proboscis and variously termed fulcrum, œsophageal sac, pharynx, &c. (Fig. 1, *f*). It is present in all Diptera and Hemiptera, and has been shewn by Menzbier, Macloskie and Dimmock to have nothing to do, morphologically speaking, with the trophi or proper mouth-parts, but is a thickening of the œsophagus-walls, which in Muscidæ send stout processes to the roof of the basi-proboscis and so secure a firm connection with the roof of the cranium.[2]

The general form of the fulcrum reminds one of a Spanish stirrup which is suspended by its supero-posterior processes (Fig.

[1] These chitin-bars (Fig. 4, *mt*) were shewn by me to be the *great tendons* of some of the trophi (*loc. cit.*). They are probably the tendons of the first maxillæ, and beir g large and rigid suggest that as a whole these maxillæ, though not much hardened, are otherwise well developed, a view which is reinforced by the presence of the palps. I shall here use "maxillary tendons" as the rendering of Kraepelin's "spangen der unterkiefer."—*G. M.*

[2] Menzbier, uber das Kopfskelett, &c., der Zweiflügler, Moscow (1880); Macloskie (*loc. cit.*, 1879); Dimmock (*op. cit.*, 1881). I gave the view that the fulcrum represents the endocranium of other insects. My friend Dimmock cautiously declined to say yes or no to this theory, and Kraepelin, without noticing what I have written on this head, here enunciates the view that it is a thickening of the wall of the œsophagus, a view which I venture to say was shewn by me to be untenable. An œsophageal chitinization must always be towards the lumen of the œsophagus, whereas Kraepelin shews that the fulcrum surrounds the œsophagus. I have compared the fulcrum of Diptera with the structures referred to in such Diptera as the mosquito, and in Hemiptera, and have not been able to decide whether they correspond; as a whole I think the probabilities are against their being homologous. Subsequent consideration, especially with reference to what has been done as to the embryology of the Diptera, has strengthened my faith in the endocranial theory.—*G. M.*

4, *fs*) to a band in the anterior margin of the cranium (*cb*). Its side-walls are strong chitin-plates, with a sinus looking backwards. The sole of the "stirrup" is double, of two chitin-plates superposed, and having a cavity between them, within which the œsophagus passes forwards (Fig. 5, *of*, *uf*). The infero-posterior extremities of the "stirrup" are prolonged into horns, one at each side (Fig. 4, *is*), which are connected by retractor-muscles (*mr*) to the cranial band (*cb*). The maxillary tendons are at their proximal extremities connected by a short muscle with the supero-posterior extremity of the fulcrum, and by a long muscle (*me*) with its anterior horn. Below the floor of the fulcrum are seen muscles running forwards, and also the trachea-like salivary duct (Fig. 5 *sd*).

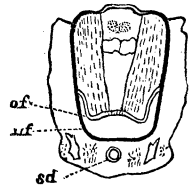

Fig. 5.—Fulcrum.

The Proper Proboscis (medi-and disti-proboscis, Fig. 3, *mp* and *dp*).—When viewed from the side, this part (representing the labium) is a cylinder, anteriorly divided into a two-lobed tip, the labellæ. Viewed from above we see that it has a superior longitudinal canal in which two unpaired chitinous stylets are embedded (Figs. 1, 4, 2, *o* and *h*). The upper one of these two stylets, the labrum (oberlippe, *o*) appears as the direct continuation forwards of the upper anterior margin of the basi-proboscis, and, like all insect appendages, is hollow, enclosing muscles, tracheæ and nerves. As the labium has a deep groove on its upper surface (Fig. 2, *up*), so the labrum has a similar groove on its under surface (*o*), and is in fact an inverted semi-cylinder with double walls. (Its lower wall was once deemed a distinct piece, epipharynx.)

The under proximal extremity is articulated to a small chitin-capsule, described by Macloskie and Becker as a triangular "binding-piece," and overlooked by other observers (Fig. 4, *sc*). This "small capsule" lies directly in front of the fulcrum, whose form it repeats in miniature. The floor of the small capsule is continuous with the under floor of the fulcrum, and the upper plate of the fulcrum-floor partially roofs the small capsule. The side-walls of the small capsule bulge out and are chitinized, giving a basis for the insertion of the under parts of the labrum, whilst the floor of the small capsule supports the second stylet, or hypopharynx.

Hypopharynx.—This, like the labrum, is a hollow cylinder with a longitudinal furrow on its upper surface (Fig. 2, *h*). Its groove meets that of the under side of the labrum, so as to complete a nutritive tube (*nc*) which opens on the distal end of the proboscis, and forms the beginning, or rather the antechamber, of the alimentary canal. Imbibed fluid penetrates this canal, then enters the "small capsule," which serves as a reservoir, passing next into the space between the double floor of the fulcrum, and so on

to the proper œsophagus. The inner cavity of the hypopharynx is, through its whole length, pierced by the salivary duct (*sd*) coming forwards from thoracic salivary glands, advancing below the floor of the fulcrum (Figs. 4, 5, *sd*), and entering the hypopharynx (not piercing it as Meinert supposed) and opening at its distal extremity. I place the proper mouth-opening at the anterior end of the "small capsule," where the labrum and hypopharynx are inserted. The labium, by its grooved upper surface, serves as a case for enclosing the stylets, as with Hemiptera. All the proboscis-parts are bound together by the thin membranous wall of the labium.

Labium (unter lippe).—This is a cylindrical evagination of the basi-proboscis, but furrowed above. Thus it serves as a bed for the nutritive canal. It is divided in front by a median slit into two motile cushions, the labellæ, which Burmeister and Erichson shewed to be the metamorphosed labial palps. The internal cavity is occupied by muscles, nerves, tracheæ and glands. Its under part is much swollen, and is strongly chitinized, the thickening extending up the sides (Fig. 3, *lp*). This under part (infe-

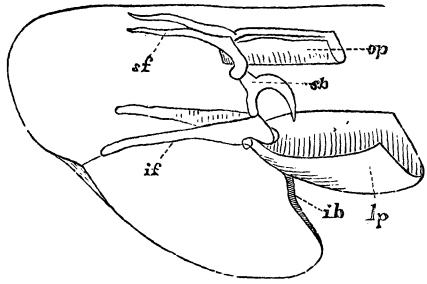

Fig. 6.—Side view of labium.

rior labial plate) supports, at its distal extremity, two short, horn-like processes which bear a stout triangular piece. On this piece is inserted a stout chitin-fork (Fig. 6, *if*) whose long legs advance forwards. The fork sends downwards a strong unpaired arcuate band (*ib*). This chitin-fork is joined to the labial plate not merely at its articulation, but also by a folding membrane which unites them along their length.[1] Free vertical motion is thus allowed to the forking parts, but the extent downwards of its excursions is limited by the thin membrane.

The upper plate (the "furrow-plate," Figs. 4, 2, *fp*) of the labial cylinder forms the bed of the channel which contains the labrum and hypopharynx. The front end of this plate is thickened and bears a strong chitin-fork (the superior fork, Fig. 6, *sf*), repeating in some measure the parts of the inferior fork, the two branches running parallel forwards, and united and limited by

[1] A similar connection by means of membrane is described by me in the maxillary suspensorium of the bee. AMERICAN NATURALIST, 1881, p. 357.—*G. M.*

membrane which connects them with the rim of the furrow-plate. From below this fork an unpaired piece (*sb*) connects it with the inferior fork, and sends backwards a hook-like process.

The thin membrane, which is continuous with the margins of the labial plate, enlarges distally and swells out so as to constitute the two large terminal labellar cushions of the disti-proboscis. In the resting condition these lie with two flat surfaces adjoining, and they have each an inner and an outer surface. The limbs of the lower forks support the outer cushion-walls. The upper forks, whose limbs run parallel, support the inner surface of the cushions. Between these supporting bars the thin membrane is sculptured in a special way. Each branch of the superior fork has, from its place of articulation with the furrow-plate, a chitin-arc running longitudinally (Fig. 7, *ca*); between

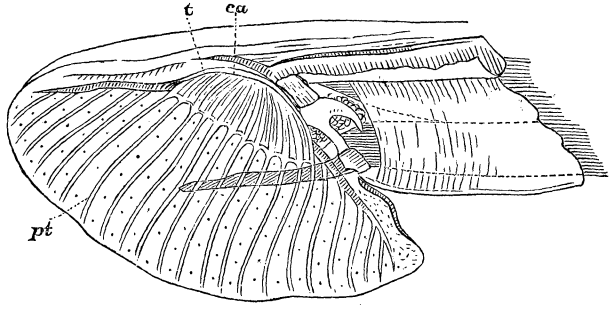

Fig. 7.—Side view of labium.

these arcs the membrane is extended.[1] The membrane has radial folds in bas-relief, soon rising to high relief, forms which depend on secondary foldings of the membrane, called by Macloskie and Dimmock "scraping teeth" or spines (Fig. 7, *t*). There are three rows of such spines, the second and third rows being foldings external to those of the order next below. These are succeeded by foldings of a fourth order which, instead of forming teeth, bend round as semicircular bars and form the beginnings of the often described pseudo-tracheæ (*pt*). The supporting arches thus have (morphologically) the same origin as the teeth. On the outer rim, where outer and inner walls merge, the pseudo-tracheæ, after diminishing distally, terminate. There are also straight supporting rods between the pseudo-tracheæ (Fig. 8, *sr*).[2]

[1] In the housefly there are only one, or occasionally two rows of teeth.—*G. M.*

[2] These supporting rods are not in the Housefly. I may add to the above that the projecting margins of the pseudo-tracheæ are crenulate with deep sinus between the adjoining crenellæ. The supporting arcs are forked alternately at opposite extremities (AMER. NAT., 1880, p. 153, Fig. 1, *C*), and each crenella is supported medially by the simple extremity of one arc, and at its two margins by the semi-forks of adjoining arcs; so that the deep sinus between crenellæ is bounded by the forked end of an arc. The fine membrane between the pseudo-tracheæ is hexagonally areolate, like the facets of the eyes, the areoles having sunken boundaries (which may flatten out when the labellæ are expanded). My observations are from the *housefly*.—*G. M.*

II. Musculature and Motile Mechanism.—1. *Movements of the basal parts of the Proboscis.*—There are two pairs of retractor muscles. One pair arise from the anterior band of the cranium (Fig. 4, *mr*) and are inserted on the inferior suspensor processes (*is*) of the fulcrum. The other pair arise from the postero-basal plate of the cranium and reach forward so as to be inserted on a cross-ridge (Fig. 3, *x*) near the end of the basi-proboscis. By their contraction they retract the thick wall-plate of the labium telescopically into the basi-proboscis. The second pair also flex the hypopharynx on the "small capsule," and the whole labium upon the fulcrum; we may term them "flexors of the labium."

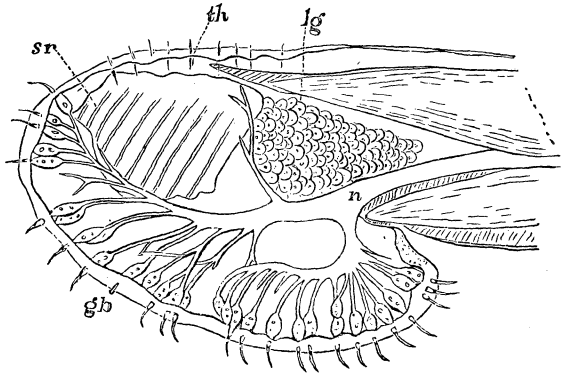

Fig. 8.—Nerves, etc., of labium.

Two pairs of weak muscles arise from the sides of the occipital foramen. One pair of these aid the unfolding of the basi-proboscis. The other run forward over the "small capsule" and seem to be inserted in the base of the labrum; they may be retractors of the labrum.

The *mode of protruding* the proboscis involves a more difficult problem. The muscle which Becker describes as drawing the fulcrum around its hinge, has no existence. The tracheal apparatus comes to exercise a powerful influence at this point. The large air-trunks after entering the head by the occipital foramen enlarge to form (seemingly two) capacious air-sacs, which, when the proboscis is extended, fill all the cranial cavity except what is occupied by the nerves and the invaginated "cranial bladder" (Fig. 1, *b*). This cranial cavity is serviceable for the retraction of the proboscis, as by the collapse of the tracheal sacs through the withdrawal of air from the head, a vacant space is left for the reception of the fulcrum. (I renounce the view once held by me that the cranial bladder aids in retracting the proboscis.) The inspiratory mechanism of the trunk by driving air towards the head causes the protrusion of the basal parts of the proboscis. The

view that the proboscis was protruded by air-pressure was long ago enunciated by Gleichen, and has been recently established by Macloskie and Dimmock by experiments made under water. I have found traces of a muscle in the head by whose action such inspiration may be assisted.

Simultaneously with the extension and swelling of the basi-proboscis, the extension of the medi-proboscis takes place. This is provided for by the articulation of the hypopharynx and labrum on the "small capsule." The long maxillary tendons (Fig. 4, *mt*) are firmly united to the chitin-wall of the labrum. From the proximal terminal knob of these tendons a strong muscle proceeds to the front horn of the fulcrum (Fig. 4, *me*). Another short muscle binds the same knob to the superior wall of the basi-proboscis. The larger pair of these muscles are extensors of the medi-proboscis.[1]

2. *Movements of the Labellæ* (disti-proboscis).—The bifurcating framework already described permits much change of the labellæ. Muscles coming from the rigid inferior plate of the labium reach the branches of the forks, and control their movements. The muscles by contracting open and spread out the labellar cushions. As the muscles become relaxed the elasticity of the bars and fork-limbs suffices to bring the whole back to its position of rest. There are no antagonizing muscles to the fork-retractors. After death these retractors act so excessively as to turn the cushion-like labellar faces outwards.

As to the swelling of the labellar cushions, Macloskie and Dimmock represent the tracheal air as the means of swelling. But careful sections shew that the tracheæ do not enter the label lar cushions, and there are no bladder-enlargements as must be present for such an office. All the parts of the labellæ not occupied by organs are filled with blood whose pale corpuscles can be seen. Hence it is clear that the swelling of the labellæ is caused by inflowing blood, as Becker supposed.[2]

[1] I have found that these muscles by alternately contracting on each side of the proboscis move its tip from side to side. The connection of the maxillary tendons with the labrum and hypopharynx is so pliable (at least in the housefly) that I question the extensor function here assigned to its muscle.—*G. M.*

[2] On this subject I must join issue with the distinguished author. The presence of blood in the lamellæ does not disprove their being distended mainly by air, if independent evidence to this effect be forthcoming; and the finer tracheal branches and sacs, not being chitinized, are not readily recognized, and may be represented by what are described below as glands. Kraepelin's figures shew that he has not sufficiently examined these structures in living specimens, for they all represent the disti-proboscis in a collapsed condition; and no reference is made to the fact that when the proboscis is distended there is always a large swelling in the inferior angle between the medi-and disti-proboscis. On cutting or pricking this swelling under water, one or two air-bubbles escape, and the labellar cushions as well as the more proximal parts instantly collapse. Nor can they be again protruded. Of course the fine air-reservoirs, when under dissection, are in the collapsed condition, and easily elude observation; but they may be seen to swell as by peristaltic movements in living specimens.—*G. M.*

3. *The Suctorial Mechanism.*—The suctorial canal begins where the paired limbs of the upper labellar fork are fixed on the extremity of the upper labial plate. The entrance is guarded by bristles to prevent the escape of fluid. Behind this are seen the tips of the labrum and hypopharynx, between which the entering fluid penetrates so as to reach the proper œsophagus.

The labrum having radial muscles between its two plates (Fig. 2, *lm*) can enlarge its lumen and so effect suction. At the triangular "small capsule" the action of the fulcrum comes into play, its muscles raising the upper floor-plate (Fig. 5, *of*), and so enlarging the cavity below and continuing the suctorial process. Thus the fluids are absorbed and forced towards the stomach.

For dissolving solid substances the secretion of the glands is provided. There are three pairs of salivary glands. The chief ones are in the thorax, with the long salivary duct resembling a large trachea (Figs. 1, 4, 5, *sd*). A second pair is in the disti-proboscis (Fig. 8, *lg*), large-celled round masses with a common duct opening near the tip of the upper labial plate. A third collection of salivary glands is at the passage of the fulcrum into the œsophagus.

The salivary secretion is spread over the labellar cushions by means of the pseudo-tracheæ.[1] Sugar, bread-crumbs, &c., being porous absorb the fluid; it is not the sugar that is absorbed by the saliva, but the saliva by the sugar.

III. Hairs and Sense-Organs.—The proboscis is covered with short hairs not supplied with nerves. Besides these there are three kinds of special hairs:

(1) The *tactile* hairs are on the upper rim of the labellar cushions (Figs. 8, 9, *th*), hollow, having a nerve with a ganglion (*tg*) below.

(2) Labial glands with bristles are on the outer margin of the labellæ (Figs. 8, 12, *gb*). Each of these bristles is supplied with a duct leading from a many-celled mass, and is grooved at one side as if for conveying a secretion outwards (Künckel and Gazagnaire deem these to be sense-organs with nerve-ganglia).

(3) There are also taste-organs over the surface of the labellæ, between the pseudo-tracheæ (Fig. 7, indicated by dots, and Figs. 10, 11). Each hair has a chitinous basal ring; its nerve is gangliated, and is perforated by an axis cylinder which reaches the surface, indicating that here we have to do with a genuine organ of special sense.

[1] An easy experiment illustrates this. Press out the proboscis, and before the labellæ swell, their surface is covered with saliva like a drop of dew. Further pressure swells the labellæ, and instantly the saliva disappears, being drawn into the now expanded pseudo-tracheæ by capillary action.—*G. M.*

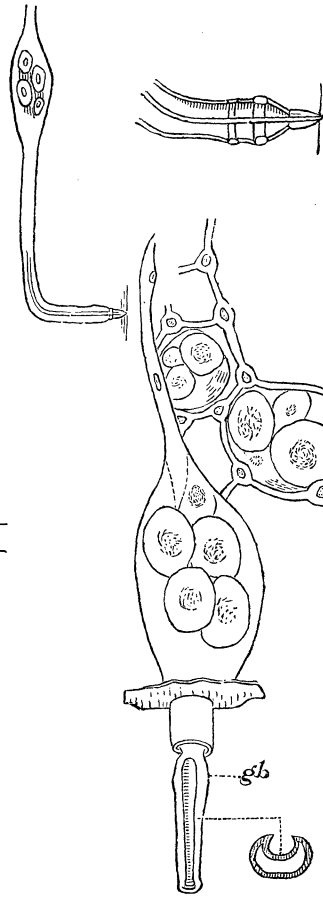

Fig. 10.

Fig. 11.

Fig. 9.

Fig. 12.

EXPLANATIONS OF THE FIGURES.

FIG. 1.—Median section of Fig. 1.
FIG. 2.—Transverse section of medi-proboscis.
FIG. 3.—Head of *Musca vomitoria*, with extended proboscis. Side view (left).
FIG. 4.—Basi-proboscis with part of medi-proboscis, with the covering membrane removed (including part of Kraepelin's Fig. 3).
FIG. 5.—Transverse sections of basi-proboscis and fulcrum.
FIG. 6.—Supporting parts of disti-proboscis.
FIG. 7.—Disti-proboscis, with pseudo-tracheæ.
FIG. 8.—Longitudinal section of disti-proboscis.
FIG. 9.—Tactile hair.
FIGS. 10, 11.—Taste organs.
FIG. 12.—Dermal glands with gland-bristle and its cross-section.

REFERENCE LETTERS.

(For all the figures.)

b, Crainal bladder.
bp, Basi-proboscis.
c, Cranium.
ca, Chitin-arch supporting pseudo-tracheæ.
cb, Band on front of cranium.
dp, Disti-proboscis.
e, Eye.
f, Fulcrum.

fp, Furrow-plate.
fs, Suspensory process of fulcrum.
gb, Gland-bristles.
h, Hypopharynx.
ib, Inferior labellar band.
if, Inferior labellar fork.
lg, Labellar glands.
lm, Muscles of labrum.
lp, Inferior labial plate.
me, Extensor muscles.
mp, Medi-proboscis.
mr, Retractor muscles.
mf, Muscle of fulcrum.
mt, Maxillary tendon.
n, Nerve.
nc, Nutritive canal.
o, Maxilla (oberlippe).
of, Upper plate of floor of fulcrum.
op, Upper labial plate.
pr, Palp-bearing ridge.
ps, Pseudo-tracheæ.
sb, Superior labellar band.
sc, Small capsule.
sd, Salivary duct.
sf, Superior fork.
sr, Supporting rods.
t, Teeth.
tg, Tactile ganglion.
th, Tactile hairs.
up, Under plate of floor of fulcrum.
x, Cross-ridge near top of basi-proboscis.

OBER'S TRAVELS IN MEXICO.[1]—In point of interest to the public and as a contribution to popular geography this book should meet with favor. To the naturalist desirous of learning something of the physical features of the vast country here described, and of its more prominent biological and ethnological characteristics, Mr. Ober has done a favor.

The work is divided into three books, devoted to Yucatan,

Aboriginals of Mexico.

Central and Southern Mexico, and the border States next to the United States, so it will be seen that the author covers a large extent of ground, indeed, the number of miles traveled (nearly a

[1] *Travels in Mexico and Life among the Mexicans.* By FREDERICK A. OBER. With 190 illustrations. Boston, Estes & Lauriat. 8vo, pp. 672.